Farallon™

Get Talking!

People are using AppleTalk® *local area networks* * in small businesses and Fortune 500 companies, in government and in universities. They're sharing printers and exchanging files, storing information and sending memos. They're working together on projects by sharing Macintosh® screens across the *network*, and tapping into the power of mainframes and minicomputers without sacrificing the independence and freedom of their personal computers. The isolated Macintosh or PC is becoming a thing of the past.

But the power of connectivity hinges on network reliability. If users can't rely on the network to be up and running every day, they won't work with it—they'll work around it. To make your network dependable, start with a strong foundation. Get down to basics. The Nitty Gritty.

Network cabling and connectors are the "plumbing" required for all network services, from electronic mail to file transfer. Our goal is to take some of the mystery out of networking by showing how you can use PhoneNET® System plumbing to build an *AppleTalk network* you can trust for a variety of tasks, today, and as your organization grows and changes in the future.

"We design, install, and service physical networks. I've been

using PhoneNET ever since I could get my hands on it.

The products work. I've had absolutely no problem."

—Bud Blalock

Vice-President, MasterCom

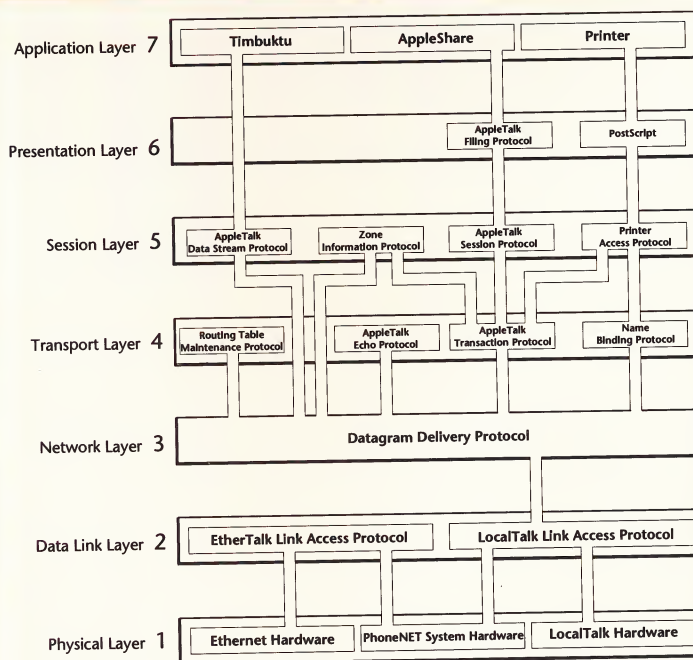* Please see glossary for definitions of all italicized items.

Free for the Taking—
AppleTalk over Telephone Wire

AppleTalk is the communications *protocol* built into all Apple Macintosh computers and LaserWriters®. It's available to devices such as the Linotronic™ printer and the IBM PC®, IBM PS/2®, and compatibles through add-in cards. The diagram shows how the AppleTalk network protocol architecture fits into the ISO/OSI reference model. Network protocols designed according to this model are structured hierarchically, with each functional layer depending on the layers below to perform a unique job.

As you see, AppleTalk operates over a variety of cabling systems, including *LocalTalk*™ and *Ethernet*™.

PhoneNET System network hardware operates at the *physical* and *data link layers* of the OSI reference model, allowing you to construct both Ethernet and LocalTalk networks with ordinary twisted-pair telephone wire. You can use the existing telephone cable in your building, taking advantage of free wire pairs already running to each desk. You'll save the

cost of installing new cable, and, more importantly, you'll gain the proven reliability of telephone star wiring *topologies*. When you use a "free pair" for the network, you're getting nearly one hundred years of research and development in telephone wiring technology at no extra charge.

Application Layer 7	Timbuktu	AppleShare		Printer
Presentation Layer 6			AppleTalk Filing Protocol	PostScript
Session Layer 5	AppleTalk Data Stream Protocol	Zone Information Protocol	AppleTalk Session Protocol	Printer Access Protocol
Transport Layer 4	Routing Table Maintenance Protocol	AppleTalk Echo Protocol	AppleTalk Transaction Protocol	Name Binding Protocol
Network Layer 3	Datagram Delivery Protocol			
Data Link Layer 2	EtherTalk Link Access Protocol		LocalTalk Link Access Protocol	
Physical Layer 1	Ethernet Hardware	PhoneNET System Hardware	LocalTalk Hardware	

Run LocalTalk at 230.4 kilobits per second and EtherTalk at 10 Megabits per second over ordinary telephone wire with the PhoneNET System.

Stars are smarter

Easy, economical star networks: PhoneNET StarConnector.

Networks change. You may need to add a few more users or an entire department. Network users may move from office to office or to another floor. The PhoneNET System allows you to make these changes easily and at minimal cost.

Because you use your building's existing telephone cable for the network, you can add or move computers, printers, and other network devices anywhere you have a telephone. Connect up to four offices in a *passive star* by joining network wire pairs together at the telephone closet. (Use a Farallon **Passive Star Wiring Kit**.) Attach network devices to telephone wall jacks with the **PhoneNET StarConnector**™. Designed
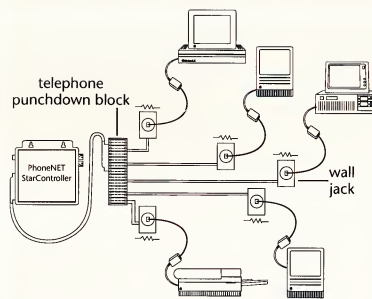

For flexible, reliable AppleTalk networks: PhoneNET StarController multi-port repeater.

specifically for telephone star wiring plans, the pre-terminated Phone-NET StarConnector automatically prevents *reflections* that can interfere with network signals. We recommend installing a **PhoneNET StarController**® at the hub of your PhoneNET System network. The StarController multi-port repeater converts your passive star network to an *active star*.

The PhoneNET StarController can isolate the network wire pairs, or "branches," connected to each port, making your network more reliable and easier to manage.

Get the most from your StarController™ hub by dedicating one port to each user. If any problem occurs—a short in the cable for example—the StarController isolates that branch from the rest of the network. If a device sends *jamming signals* onto the network, the StarController™ hub automatically shuts

down the affected port. Users on all other ports continue working undisturbed.

Turn ports on and off using **StarCommand**™ **2.0**, the network management software included with the PhoneNET StarController. With one user per port, the rest of your network stays up and running when you shut down a port to troubleshoot or move a user to a new office.

The PhoneNET StarController hub can support up to four branches and 3,000 feet (914 meters) of cable on each of its 12 ports, but you'll reap the full benefit of its management capabilities by connecting only one device per port. (See "Network Manager's Toolbox" later in this booklet for more on managing your network with StarCommand.)
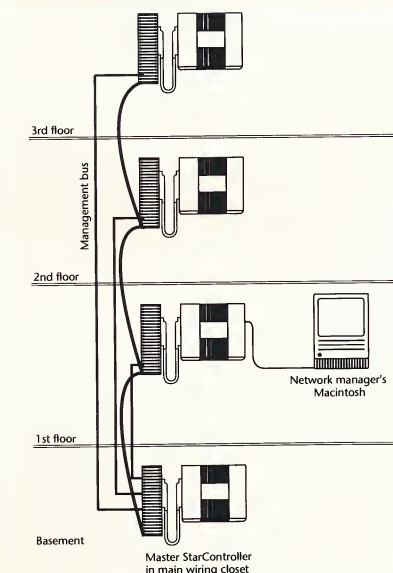

Make your network worry-free: install a PhoneNET StarController multi-port repeater.

Topology (230.4 kbps)	22 gauge	24 gauge	26 gauge
Daisy chain	n/a	n/a	1800 ft.
Backbone	4500 ft.	3000 ft.	1800 ft.
4-branch Passive star (each branch)	1125 ft	750 ft.	450 ft.
12-branch Active star (per port)	**3000 ft.**	**2500 ft.**	**2000 ft.**

PhoneNET System wiring guidelines at LocalTalk speeds.

Large networks won't get out of hand when you build them around PhoneNET StarControllers.

Dual jacks permit daisy chains: PhoneNET Connector.

As the table shows, maximum cable length varies depending on the topology you choose for your network. If you're installing a small or temporary network, a *backbone* or *daisy-chain* topology could be a practical choice. Use the dual-jack **PhoneNET Connector** for these topologies (or when connecting DB-9 devices such as the Macintosh 512).
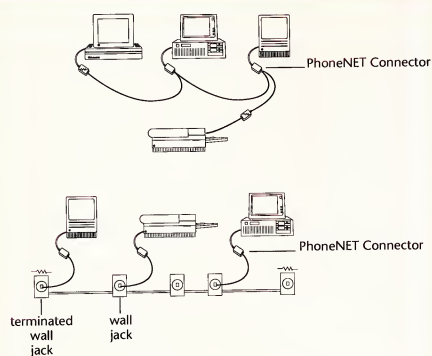
Expanding to an active star topology is easiest if you start with a passive star topology. Of the four topologies, only the active star accommodates large numbers of users while providing the flexibility to expand and reconfigure the network.

Use PhoneNET Connectors to build backbone or daisy-chain networks with ordinary telephone cable.

Good-bye Growing Pains

Use the **PhoneNET® Repeater** to extend your LocalTalk network over long distances. The PhoneNET Repeater amplifies and reclocks network signals, allowing you to double total cable length. By chaining together multiple Repeaters, you can run nearly seven miles of cable, going from building to building on a campus-wide network. You could connect a laser printer in the Research Department to a StarController hub in the basement of the MIS building, using two wire pairs and two PhoneNET Repeaters to traverse up to 9,000 feet (2,743 meters) between the buildings.

Reclocking network signals for accurate transmission: PhoneNET Repeater.

We recommend a maximum of 48 devices per network, subject to traffic limitations. If your network is used heavily, you may want to keep it smaller. Using a *router* from Apple or another vendor, you can join individual networks into *internets* supporting hundreds of users. Often referred to as a *"bridge,"* a router works by electrically separating two sections of cable, passing through only traffic addressed to devices on the other side.

Backbone
(up to 4,500 feet)

Passive Star
(Total Length of Branches up to 4,500 feet)
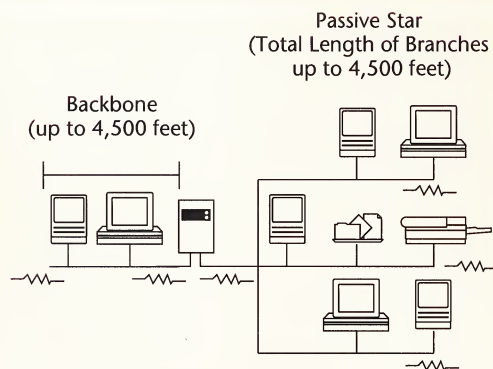
Double your distance with the PhoneNET Repeater.

"I don't ever have to go into the ceiling tiles anymore–I'm no longer covered with ceiling dust. Once we wired in PhoneNET, using the existing telephone system, we no longer had to be worried about the physical connection. Whenever we had to change something before, we had to remove the ceiling. The StarController system makes moving equipment as easy as moving a telephone."

—Roy Roper
Administrator of Local Area
Network Resources for
Macintoshes
University of Illinois
at Urbana Champaign

Not "Either/Or"—

With a PhoneNET System network in place, you can share a common printer among several Macintosh computers. But your network offers much more. You'll want to consider adding network services such as:
• electronic mail
• centralized or workstation-based file servers
• **Timbuktu**™, Farallon's screen sharing and file transfer software
• RS-232 servers for sharing modem or mainframe access.
As you add services, and as more and more users take advantage of them, network traffic will increase. This makes network reliability even more critical. Think of your network as a freeway system for automobiles. Light traffic usually moves well even if there are a few potholes. But when traffic gets heavy, road construction or a traffic accident can cause backups that last for hours. And you're sure to get traffic jams at bridges and freeway exits. Let's explore how a PhoneNET System network can help you manage traffic on a busy network.

You Take the High Road, I'll Take the Low Road

Start by monitoring network performance with Farallon's **Traffic-Watch**® software. If users complain that LocalTalk is too slow, analyzing traffic patterns with TrafficWatch will help you discover the most cost-effective way to get networking jobs done faster. TrafficWatch can help you determine when to install a router. Or how to place existing routers correctly, avoiding bottlenecks between users and shared devices, and preventing traffic jams before they occur.

But if the problem is heavy traffic, you may need to widen some roads. Just as road systems are made up of neighborhood streets, boulevards, and freeways, network routes should match users' needs. What if you could connect light traffic areas with "neighborhood streets" and channel the heaviest network traffic along "freeways"? And give each person exactly the network he or she needs—no more, no less?

With a PhoneNET System network, you can. PhoneNET Ethernet products run Ethernet over twisted-pair telephone wire, allowing you to construct hybrid networks including both Ethernet and LocalTalk connections.

While 230.4 kilobits per second LocalTalk is sufficient for most users, those who often find themselves staring impatiently at the wrist-watch on their Macintosh screens can be more productive on a faster network. With *signaling speeds* of 10 megabits per second, Ethernet provides the performance they need. Even when many people use the network at the same time, Ethernet continues to deliver the same fast data transfer rates. A sales representative pulling up a customer file from a shared database (while the customer waits on the telephone), an engineer downloading a CAD document from the server, and a graphic artist sending a layout to the print spooler are all people who could benefit from Ethernet.
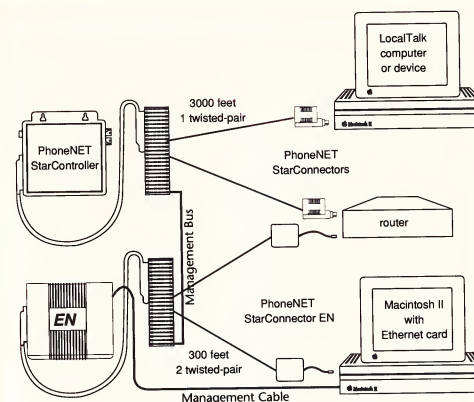
Power to the people (who really need it). Make every network dollar count by delivering high-speed performance directly to users who need it most.
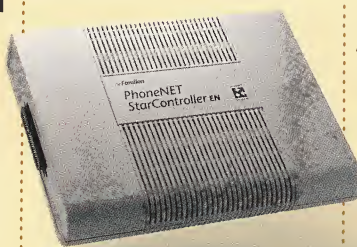
"EitherNET"

• Four pairs of un-
shielded twisted-pair
telephone wire to every
station.
• Maximum 328 feet
(100 meters) from
station to wiring closet.
• Dual RJ-45/RJ-11 wall
plates at each station.
• LocalTalk PhoneNET
Connector or StarConnec-
tor **or** Ethernet StarCon-
nector EN attached to
every network device.
• One user or device per
StarController port.
• Ethernet and LocalTalk
PhoneNET StarControllers
in the central telephone
closet or computer room.
• Additional StarCon-
trollers as necessary in
satellite wiring closets.
• StarCommand on the
network manager's
Macintosh to monitor
LocalTalk and Ethernet
StarControllers across
the management bus.

Installing an EitherNET

The **PhoneNET StarCon-
troller EN**™ and **Phone-
NET StarConnector EN**™
are the components you
need to add Ethernet
performance to your
network. You can easily
integrate Ethernet and
LocalTalk using a Phone-
NET System active star
topology. If you're
installing a new Local-
Talk network and want
the option to add
Ethernet in the future,
set up your network now
in accordance with our
twisted-pair Ethernet
guidelines. Ethernet
requires two wire pairs,
and each device must be
within 328 feet (100
meters) of a dedicated
StarController EN port.
By following our Phone-
NET System optimal
installation guidelines,
you'll be able to add
Ethernet stations as you
need them anywhere on
the network.

The advantage of star topologies,
plus Ethernet performance:
PhoneNET StarController EN.

Ethernet over twisted-pair:
PhoneNET StarConnector EN.

To upgrade a station
from LocalTalk to Eth-
ernet, replace the
PhoneNET StarConnector
with a StarConnector EN.
(Macintosh computers
and many other devices
require an Ethernet add-
in card.) At the tele-
phone closet, connect a
PhoneNET StarController
EN to any existing
Ethernet cabling with the
appropriate transceiver,
or to your LocalTalk Star-

Controller with an
AppleTalk to Ethernet
router. With popular com-
munication software
such as Ap-
pleShare® and
TOPS®, users will
have access to
printers, servers,
and workstations in both
Ethernet and LocalTalk
zones.

Stay with the Standard

PhoneNET EN™ compo-
nents comply with *IEEE/
CCITT 802.3* Ethernet
standards and are
designed for compatibil-
ity with future products
based on the emerging
10BASE-T standards for
twisted-pair Ethernet.
PhoneNET EN supports
Macintosh computers,
IBM PC or PS/2 comput-
ers and compatibles,
Sun® workstations, DEC®
VAX® minicomputers—
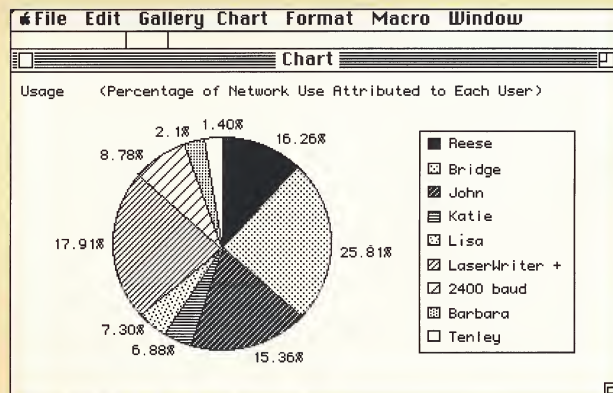any device with a stan-
dard 802.3 AUI connector.

Since networks are constantly evolving, the task of network management is an ongoing one. Fortunately, the Phone-NET System includes network management software to make the job easier.

As an example, you may have users clamoring for a new laser printer because they're tired of waiting in long print queues. To decide whether or not a new printer would solve the problem, use **TrafficWatch**® to measure traffic on your LocalTalk network over a period of time. With TrafficWatch macros, you can create a pie chart showing how much each person uses the printer, and a bar graph indicating the percent of total network traffic the printer receives. Your analysis could lead you to decide that the best

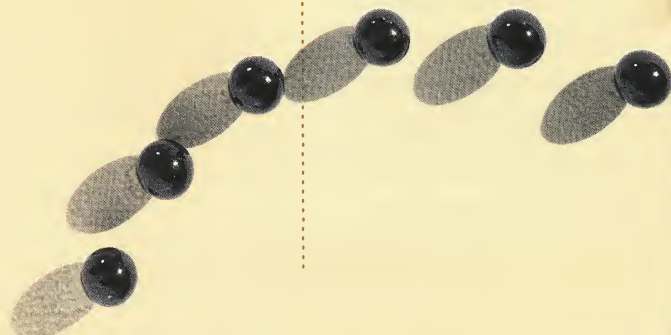solution is to divide the network into two zones, with a laser printer for each.

Many LocalTalk network users will find the **PhoneNET CheckNET**® desk accessory handy for locating devices on the network and checking hardware connections between computers, servers, and printers. Licensed for ten users, CheckNET displays, sorts, and finds both 'Ethernet and LocalTalk devices across multiple zones.

When guesswork isn't good enough, TrafficWatch helps you make informed decisions.

See what's out there with PhoneNET CheckNET.

StarCommand 2.0™ software, included with the PhoneNET StarController and the PhoneNET StarController EN, displays traffic load for both Ethernet and LocalTalk sides of the network, and allows the network manager to name and re-configure all StarController ports. StarCommand offers a high level of security, with a dedicated connection to the network manager's Macintosh and a password.

The network manager can isolate problems by using StarCommand to turn ports on and off. Most importantly, he can access StarCommand over the management bus even if the rest of the network is down. If network problems occur, the network manager won't get stuck in the middle of the problem—StarCommand's management bus, like a frontage road along a freeway, guarantees him access to all StarControllers.

StarCommand immediately notifies the network manager of problems, while the StarController automatically isolates jamming signals from network devices by shutting down the affected port, reactivating it only when jamming signals have cleared.
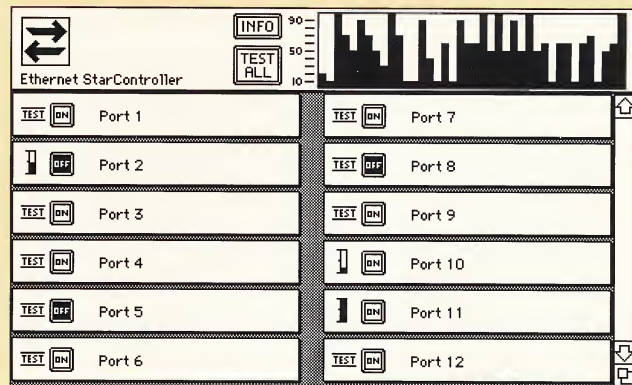
Troubleshoot Ethernet and LocalTalk connections with StarCommand from any networked Macintosh, using password-protected **Timbuktu**™ software to control the network manager's Macintosh remotely*. (Use Timbuktu/ Remote™ to manage your network from another city, over a modem connection.)

Your best ally in network management: StarCommand cuts problems down to size by letting you isolate network branches.

*One copy of Timbuktu is required for each Macintosh.

"We standardized on Farallon PhoneNET because of reliability and the star configuration. As a design engineer, I'm aware of the obvious advantages of an active star configuration. Our network's been up 100% of the time since it was installed. I know what works—we'll stick with Farallon."

—Dave Glawson

Regional Support Manager for the Los Angeles Business Region, Apple Computer

AppleTalk network technology has developed at an extraordinary rate. And PhoneNET has kept pace. Five years ago, Apple introduced *LocalTalk cable* and *connector boxes.* Four years ago the first PhoneNET Connectors shipped, enabling people to build local area networks with ordinary telephone wire. Today nearly a million PhoneNET Connectors are installed world-wide, and twisted-pair is the medium of choice for AppleTalk networks.

PhoneNET Connectors were designed from the outset to provide an easy upgrade path to ISDN (Integrated Services Digital Network). ISDN is now in operation in several areas in the United States, Japan, and Europe, and should replace analog telephone service in most businesses by the late 1990s. Follow our PhoneNET System Optimal Installation guidelines, and you will be able to run LocalTalk, ISDN, or Ethernet to each workstation, connecting your intra-office network with an international ISDN.

By transmitting voice and data over the same line, ISDN opens up exciting possibilities for enhancing communications. Farallon's **Timbuktu/ Remote**™, long-distance cousin to Timbuktu, works over today's analog telephone lines to let you operate and exchange files with a Macintosh in another city*. But, like all computer services taking place over telephone lines, Timbuktu/Remote requires a modem at each location. ISDN makes the modem unnecessary. With an ISDN link, you can talk to a co-worker in another city and simultaneously observe her screen with Timbuktu/Remote over a single telephone line—at data rates much faster than those available now. **Stay tuned!**

*One copy of Timbuktu/Remote and a modem (9600 bps recomended) is required at each location.

Glossary

10BASE-T Ethernet standard A standard being developed by the IEEE 802.3 10BASE-T committee. It allows for 10 Mbps baseband Ethernet communications over twisted-pair cabling (standard telephone wiring).

Active star topology Network wiring scheme consisting of two or more *cable segments* joined at the center by a multi-port repeater.

AppleTalk Network System Generally referred to simply as "AppleTalk." Software, protocols, and overall structure (architecture) providing the capability for communications and resource sharing among computers, printers, and other peripherals.

Bridge A device joining two or more cable segments into a single network. Operates at the data link layer of the AppleTalk protocol stack by filtering packets between cable segments based on node address. One node on each cable segment may transmit signals simultaneously.

Backbone topology A network wiring scheme whereby devices are joined by short taps to a single cable segment. Also called trunk or bus topology.

Cable segment A continuous piece of cable. Several network nodes may be attached to a single cable segment, but only one node can access it at a time. The maximum number of nodes that can be attached to any cable segment is determined by the electrical characteristics of the cable and physical layer protocols (e.g., for 10BASE-T Ethernet, the limit is 1; for Apple's LocalTalk cable, the limit is 32; for Phone-NET LocalTalk cable, the limit is 48). These limitations are subject to traffic.

Daisy-chain topology A network wiring scheme consisting of short lengths of cable interconnecting network devices in a chain fashion.

Data link layer The second layer in the OSI reference model, governing the transmission and reception of data on the physical medium and the detection of errors resulting from noise or collisions.

Ethernet Local area network hardware and cable allowing data transfer rates of 10 Mbps and incorporating a Carrier Sense Multiple Access with Collision Detection (CSMA/CD) protocol. Ethernet media include thin wire coaxial cable, thick wire coaxial cable, optical fiber, and unshielded twisted-pair cable.

EtherTalk AppleTalk protocol running over Ethernet cabling.

IEEE/CCITT 802.3 Subcommittee of the Institute for Electrical and Electronics Engineers' Committee 802 for industry LAN standards. 802.3 was formed to develop industry standards for Ethernet in accordance with the ISO model.

Internet Two or more networks (each with a unique 16-bit address) connected by routers.

ISO/OSI model Developed by the International Standards Organization (ISO) in the late 1970s/early '80s, the Open Systems Interconnection (OSI) reference model defines a network protocol architectural framework consisting of seven layers.

Jamming signals Refers to a device continually sending packets without waiting for the network backbone to clear. This prevents any other device from sending packets.

Local Area Network (LAN) Typically, a network that is confined to a single building or campus, consisting of fewer than 1,000 nodes.

Nitty-Gritty Shopping List

For LocalTalk:

PhoneNET StarConnector™ — Single-jack, pre-terminated connector recommended for star topologies. DIN-8 only.

PhoneNET® Connector — For daisy-chain or backbone topologies. Available for DIN-8, DB-9, or DB-25 AppleTalk ports.

PhoneNET StarController® — One for every 12 network devices is optimal for LocalTalk networks.

PhoneNET® Repeater — To build longer LocalTalk networks (up to 6.8 miles or 10.9 km).

For Ethernet:

PhoneNET StarConnector EN™ — Attach directly to the AUI port of any Ethernet device.

PhoneNET StarController EN™ — Connects up to 12 devices over twisted-pair Ethernet.

Software and Accessories:

PhoneNET CheckNET® and TrafficWatch® — Software tools for the well-managed network.

Telephone cable, kits, and wiring accessories — Full line available.

Get What's Coming to You

If your network isn't doing the job for you, it should be! Call Farallon Technical Support for additional information on designing and installing a PhoneNET System network. We'll be glad to refer you to your nearest Farallon reseller for PhoneNET System products.

Get talking!

I'm interested. Tell me more about Farallon products.
☐ Give me a call.
The best time to reach me is_____.

☐ **Please send me information on:**

☐ **PhoneNET System**
PhoneNET Connector
PhoneNET StarConnector
PhoneNET StarController
PhoneNET Repeater
PhoneNET StarConnector EN
PhoneNET StarController EN
TrafficWatch
PhoneNET CheckNET

☐ **Multimedia**
MacRecorder Sound System 2.0
ScreenRecorder

☐ **Collaborative Computing**
Timbuktu 3.0
Timbuktu/Remote
Timbuktu/Remote Access Pack
Portable Pack
Remote/WakeUp Cable

Name: ....

Title: ....

Company: ....

Street Address or PO Box: ....

City, State, & ZIP: ....

Telephone: (.........)...

☐ I 'm interested in reselling Farallon products

Comments:..
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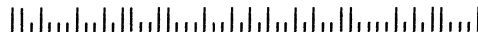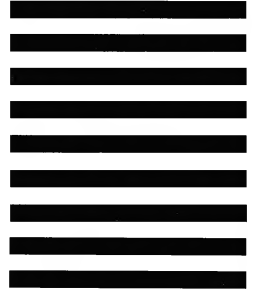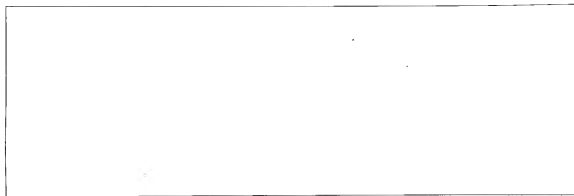
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2000 Powell St. Suite 600
Emeryville, CA 94608-9905
USA

PhoneNET

Look for the PhoneNET System logo when you buy network hardware and software products. It is your best assurance of quality and reliablity.

System